

**"iDEPTHing" before Prestack Time Migration**

**Calibration of RMS Velocities before Migration and Trend Fitting with Geostatistical Interpolation**

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**Curved Ray Prestack Time Migration**

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**"iDEPTHing" before Iterative Prestack Depth Migration**

**Migrated Time Data Velocity Model**

**Calibration of Interval Velocities before Migration, and Trend Fitting with Geostatistical Interpolation (and possibly Integration of Sonic Logs)**

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**Initial or Best Model**

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**Iterative Prestack Depth Migration**

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**Velocity Update**

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Y

N

Recalibrate?

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Image Consistent

N

Validate - tie into well data

N

Y

Y

**Figure 1**

The two basic Conceptual Steps of one preferred embodiment of the current invention for RMS velocity calibration, including trend fitting, before prestack time migration and interval velocity calibration before prestack depth migration.

# Velocity Calibration and Trend Fitting, before Curved Ray Prestack Time Migration

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**Edit**

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Compute RMS velocity and Interval Velocities from selected seismic data location and sample depth:

Edit RMS and Interval Velocities, using geological constraints to extent available.

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Resample and apply least-square filter to RMS velocities. Edit RMS velocities and interval velocities using interactive dual windows.

43

Select Stratigraphic Horizons.

**Figure 2**  
The Steps for Velocity Calibration and Trend Fitting ("iDEPTHING") before Curved-Ray Prestack Time Migration.

**Calibration**

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Compute variogram models for velocity trends from seismic velocities.

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For calibrating RMS velocity for curved ray prestack time migration, geostatistical Kriging is to be used for interpolation of scale factors to RMS velocity locations.

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Edit checkshot and/or other (hard) well data.

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Compute (RMS and/or Interval) velocities from hard data.

48

Interpolate seismic velocities to locations of (hard) well data.

49

Compute scale factor.

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Interpolate scale factors using Kriging.

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Compute calibrated RMS velocities.

**Further Trend Fitting**

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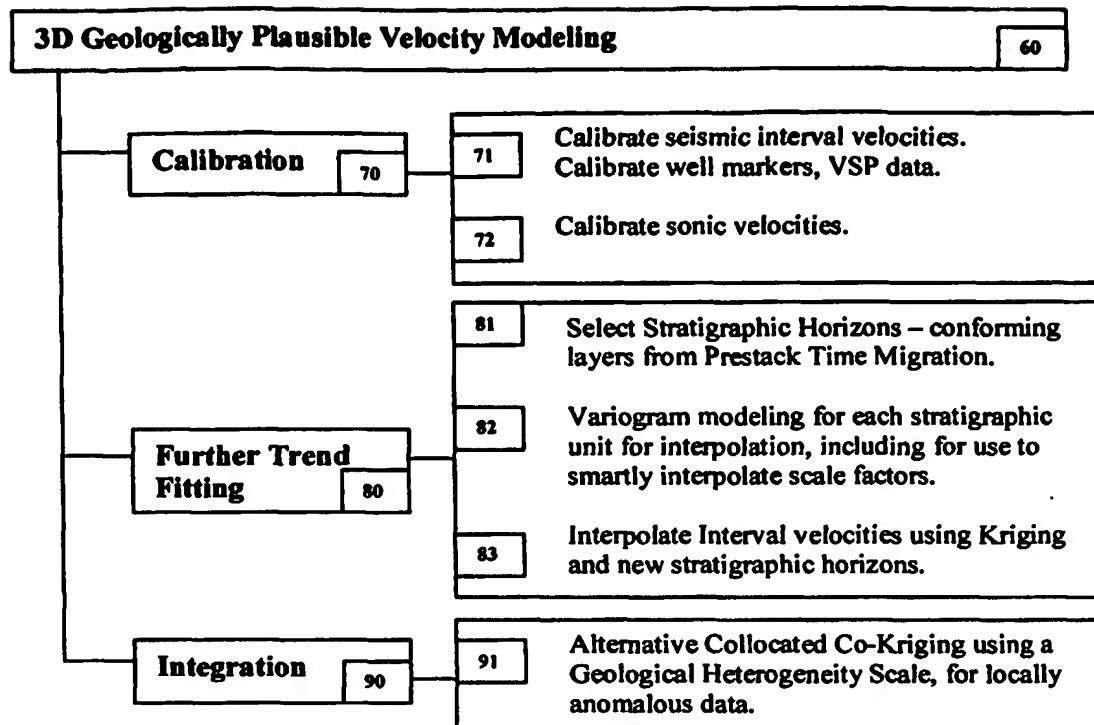
Match time slice of seismic velocities with geologic trends.

54

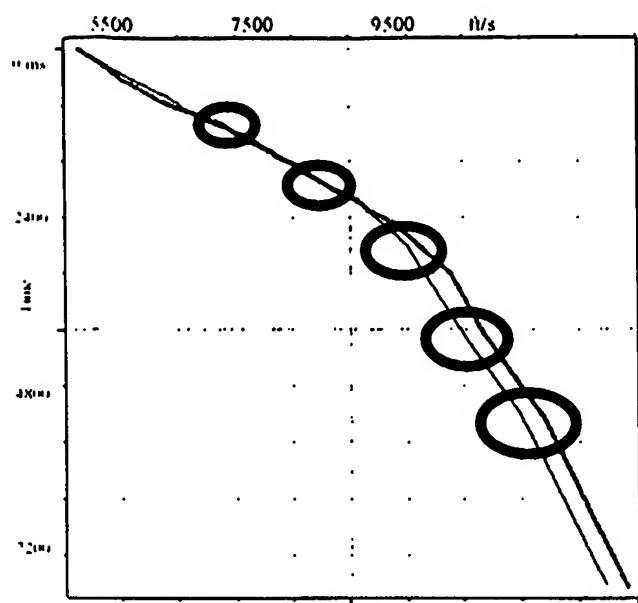
Compute variogram models and match with geologic trends.

55

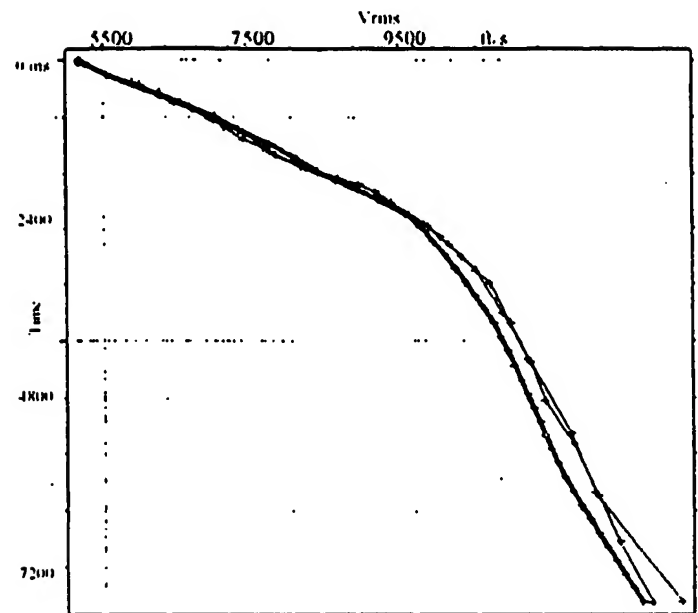
Interpolate RMS velocities using Kriging.



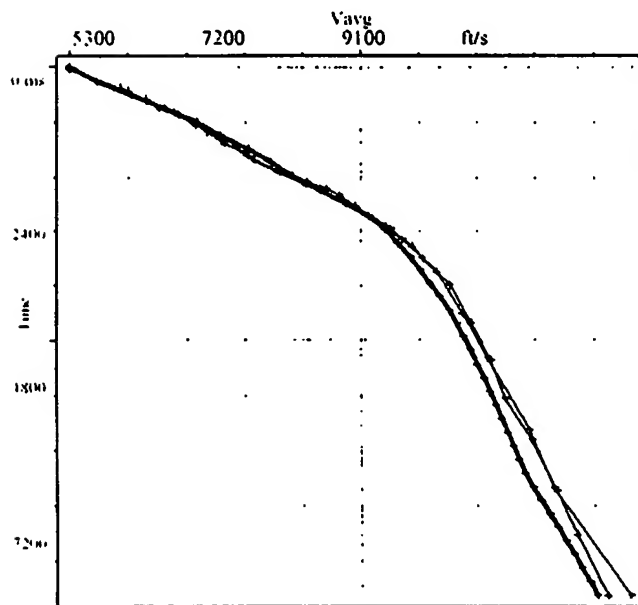
**Figure 3**  
The Steps for Constructing a Geologically Plausible Velocity Modeling for Prestack Depth Migration.



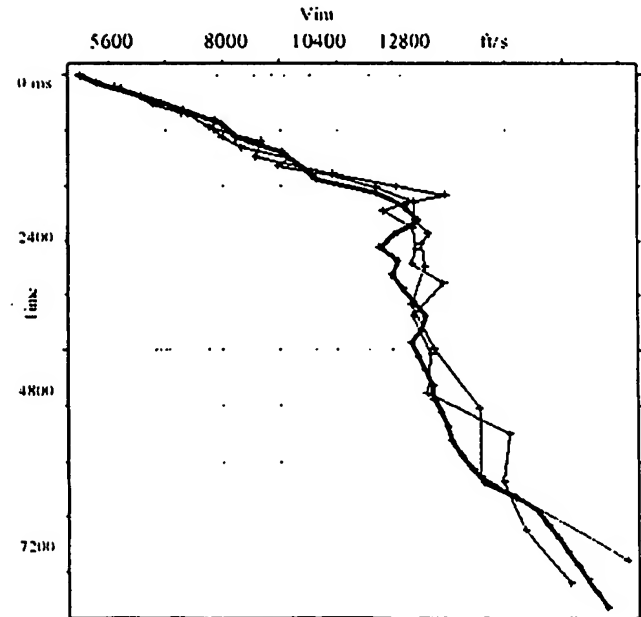
(a) Stacking Velocity Semblance



(b) RMS Velocity

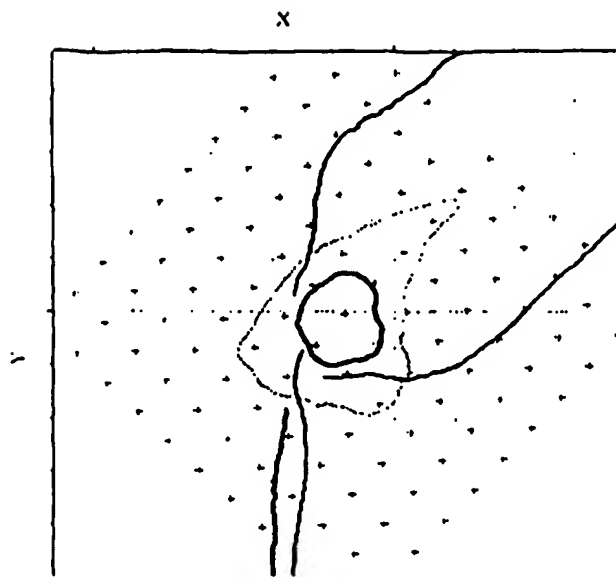


(c) Average Velocity

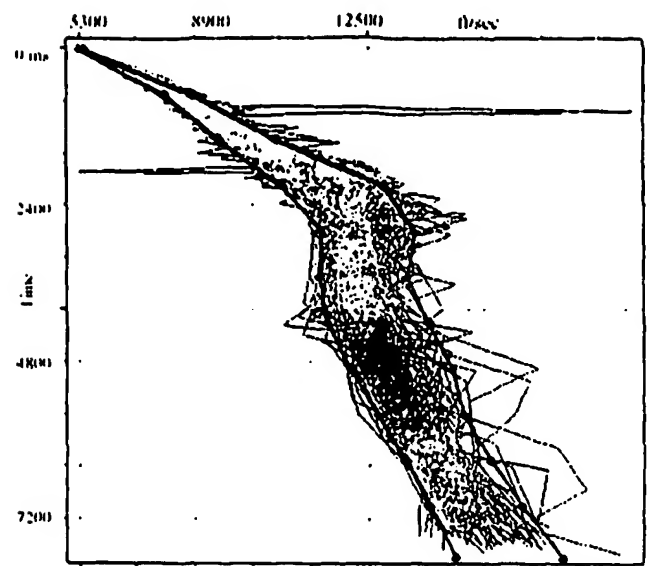


(d) Interval Velocity

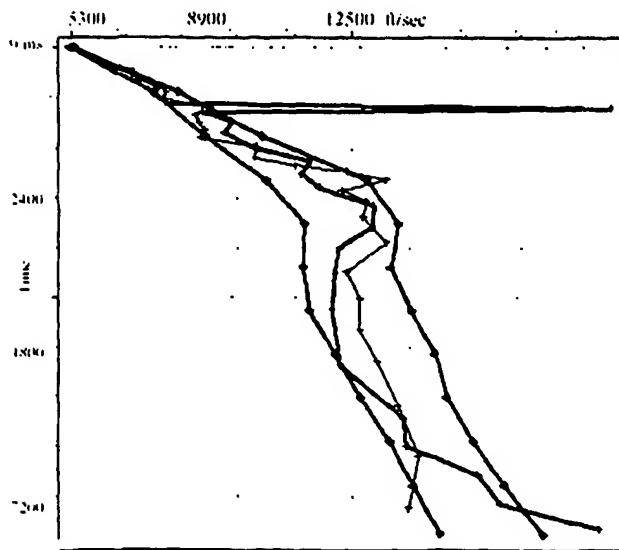
Figure 4



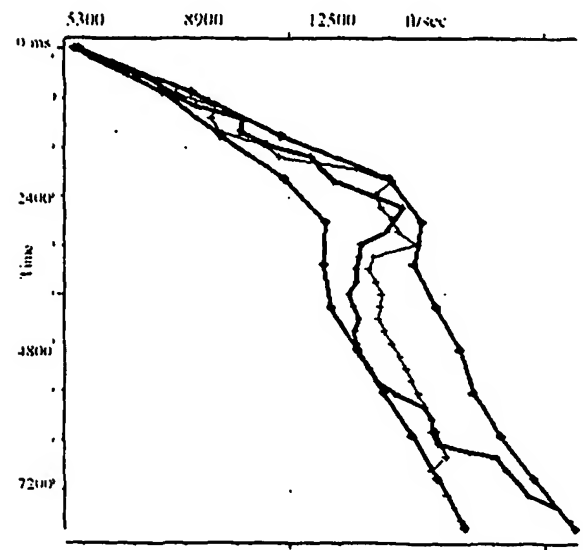
( a ) Base Map



( b ) Interval Velocity



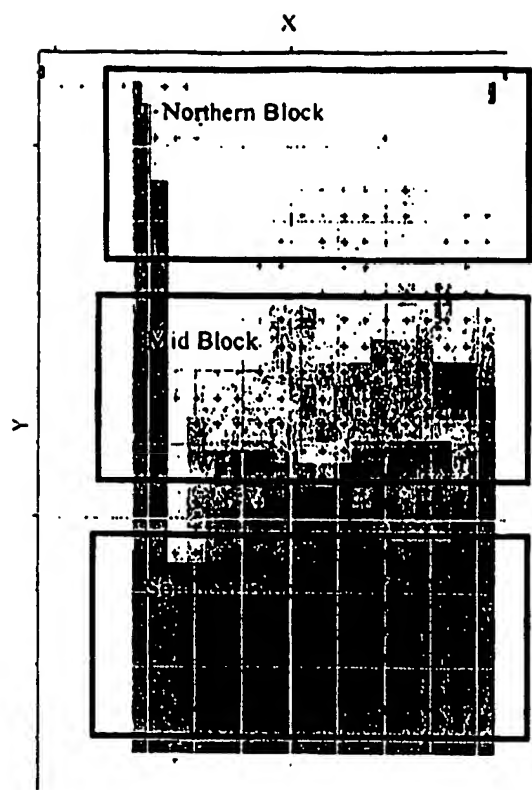
( c ) Interval Velocity



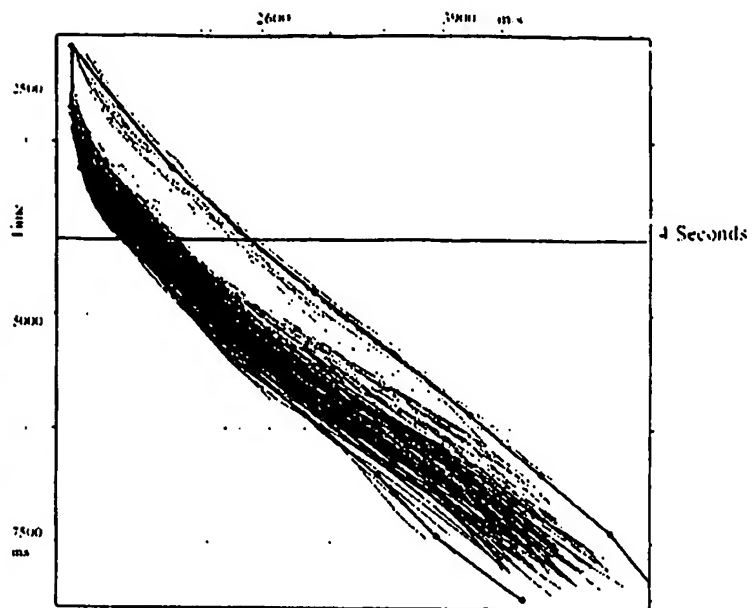
( d ) Interval Velocity

Figure 5:

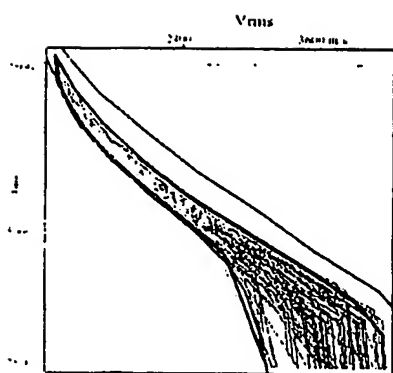
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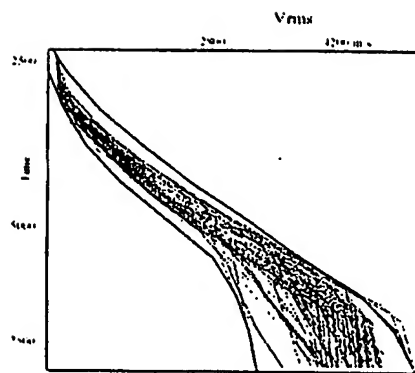
(a) Survey Area



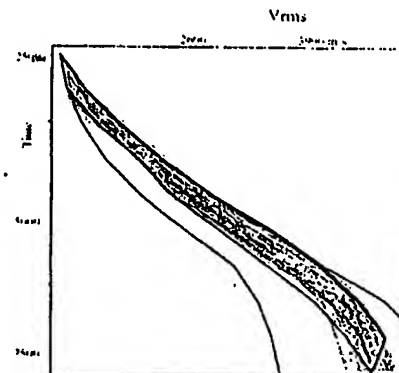
(b) RMS Velocity vs. Time



(c) Northern Block



(d) Mid Block



(e) Southern Block

Figure 6

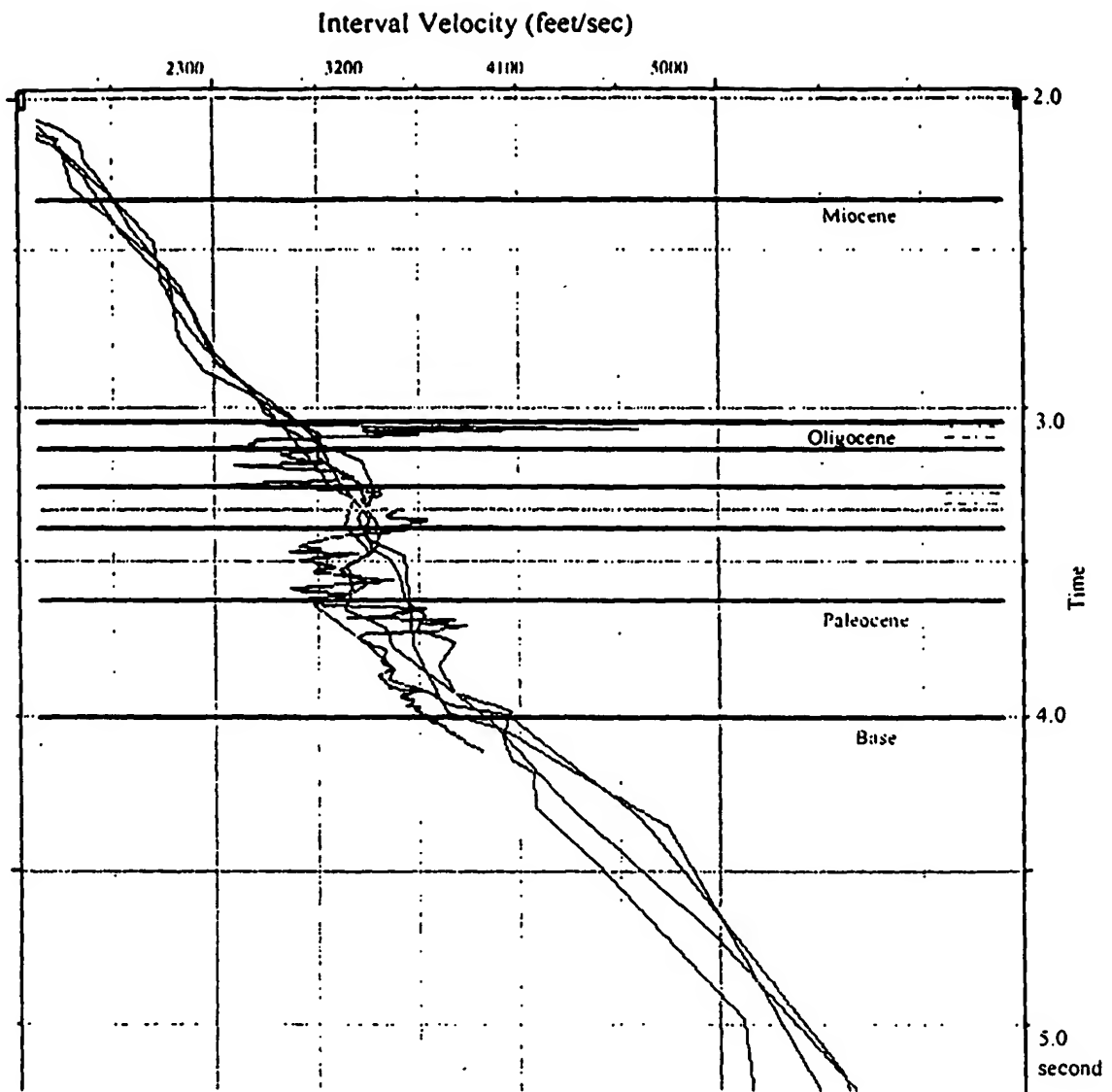
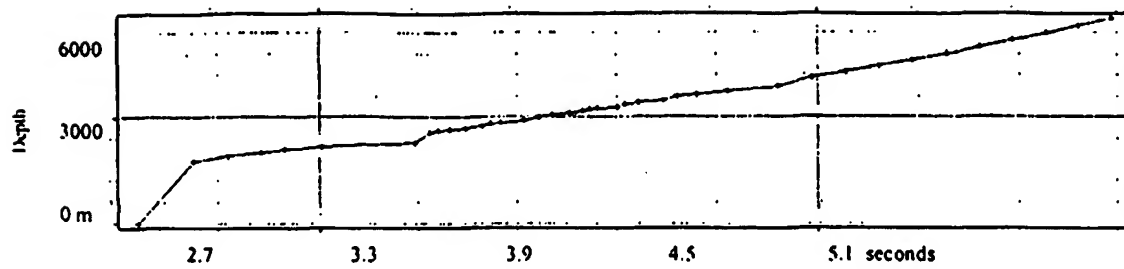
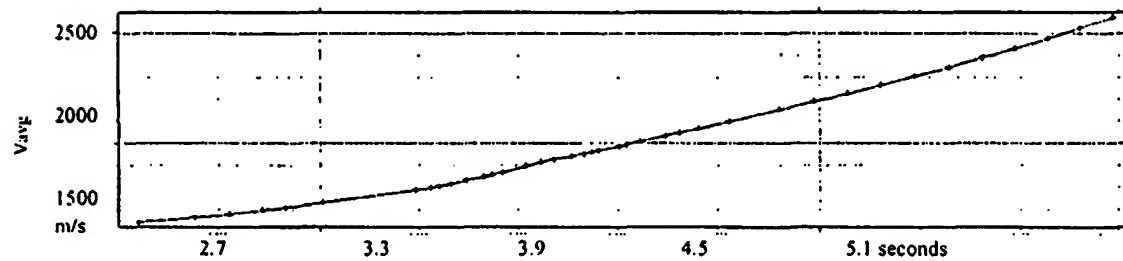


Figure 7

(a) Time vs. Depth



(b) Time vs. Checkshot\_Average\_Velocity



(c) Time vs. Checkshot\_Interval\_Velocity

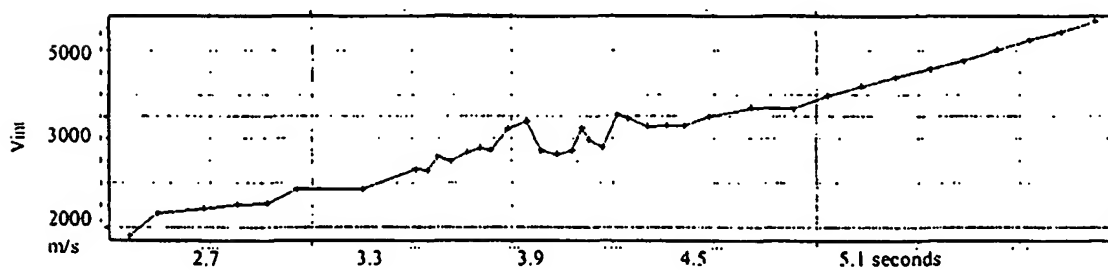
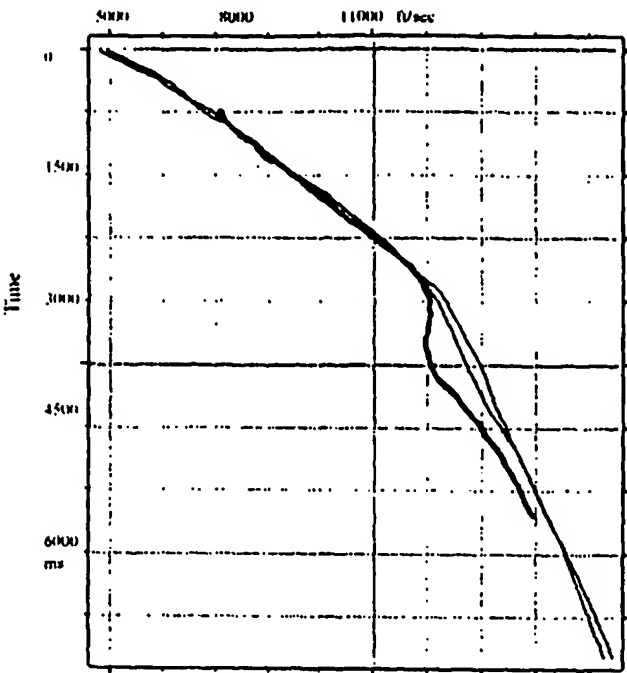
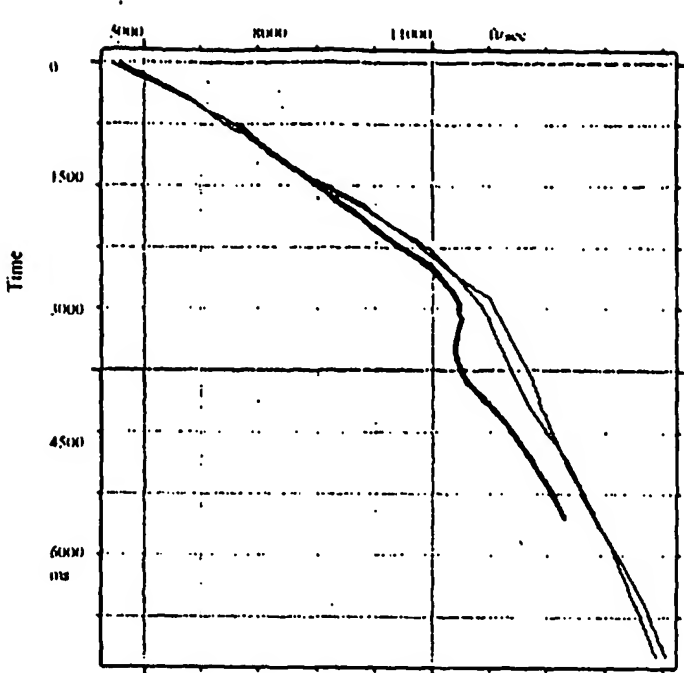


Figure 8

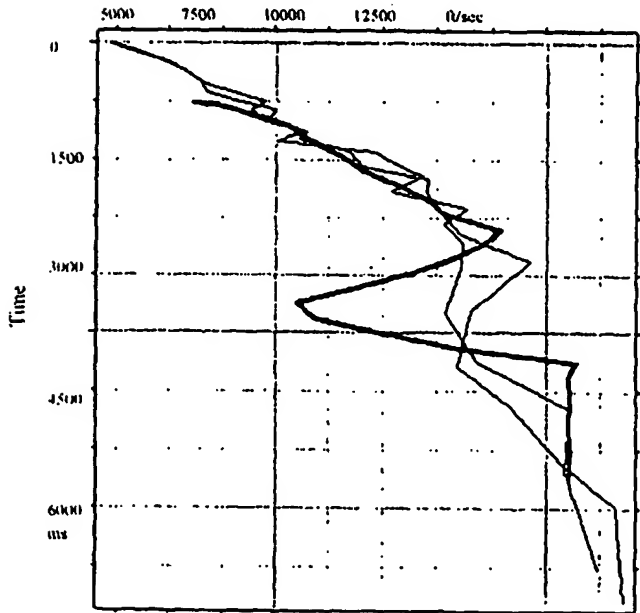




( a ) Average Velocity



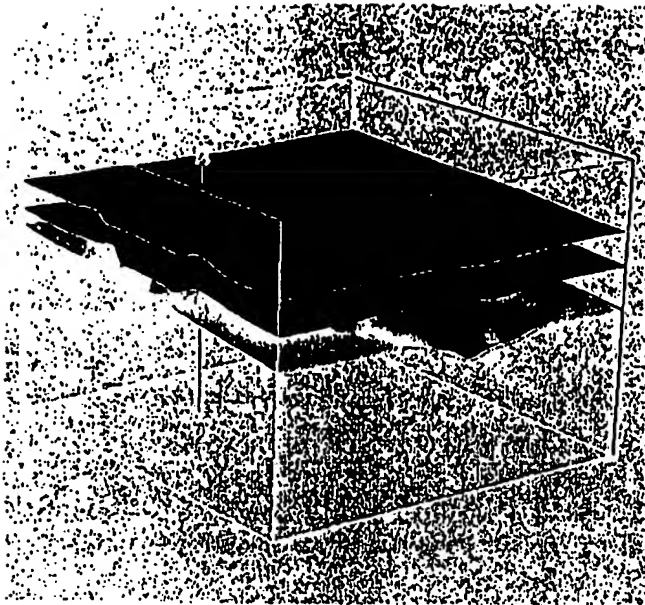
( b ) RMS Velocity



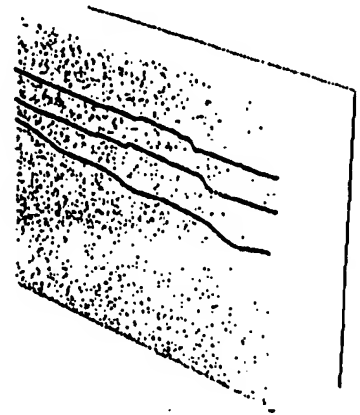
( c ) Interval Velocity

Figure 9 Checkshot Velocity

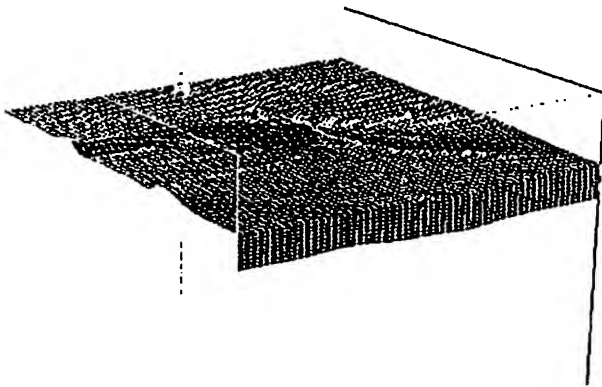
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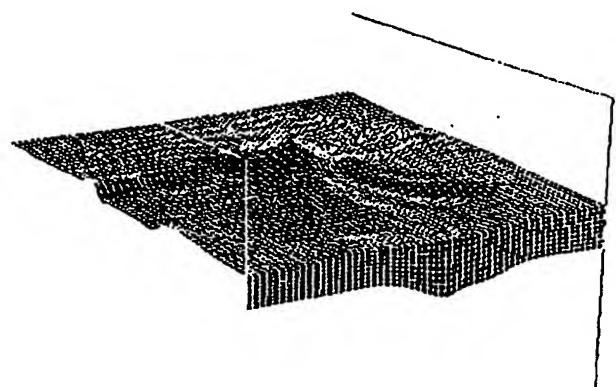
( a ) Stratigraphic Surfaces



( b ) Cross Section



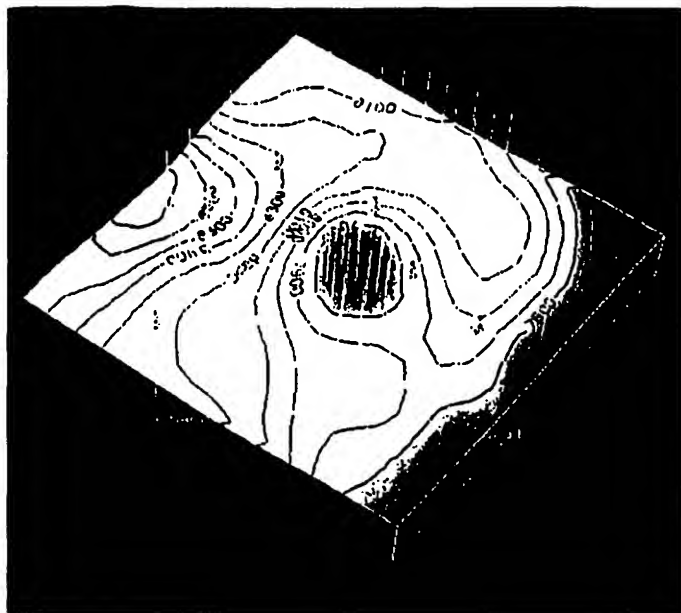
( c ) Upper Stratigraphic Unit



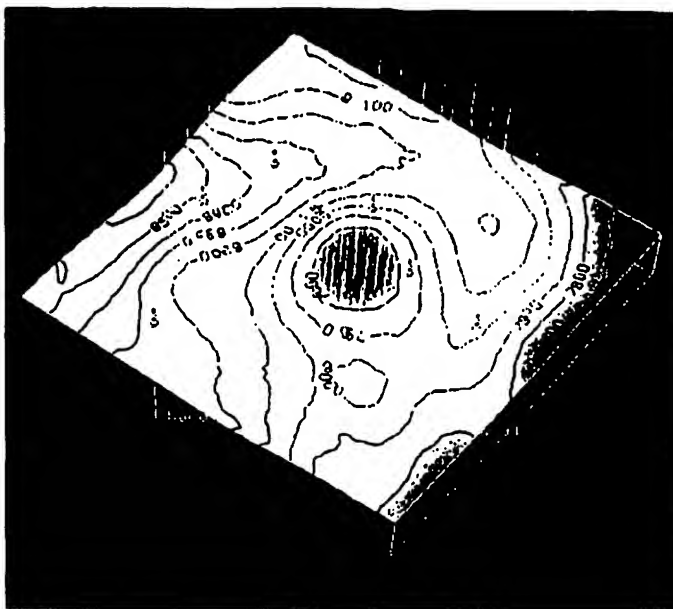
( d ) Lower Stratigraphic Unit

Figure 10

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(a) Pre-calibration Seismic Velocity

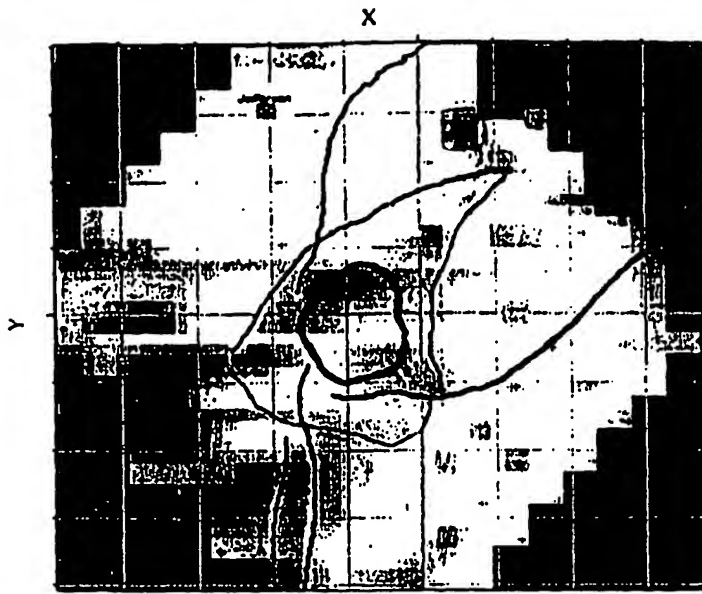


(b) Post-calibration Seismic Velocity

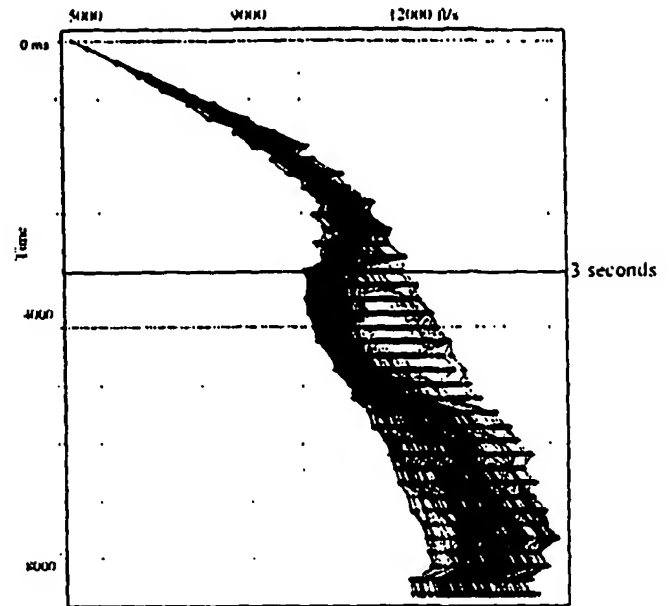
Well	Seismic Velocity	Well Velocity	Scale Factor	Calibrated Velocity	Marker Depth
1	7941.8	8009.305	1.0085	8009.55	5055.46
2	7830.99	7834.905	1.0005	7834.94	4730.72
3	7842.7	7874.855	1.0041	7875.18	4790.81
4	8316.04	8324.19	1.00098	8324.12	5590.71
5	8537.02	8356.035	0.97879	8356	6077.98
6	8226.63	8274.591	1.00583	8274.6	5641.66

(c) Calibration Table: Velocities before and after calibration

Figure 11



(a) Velocity Trend Map at 3 seconds



(b) Interval Velocity Trend

Figure 12

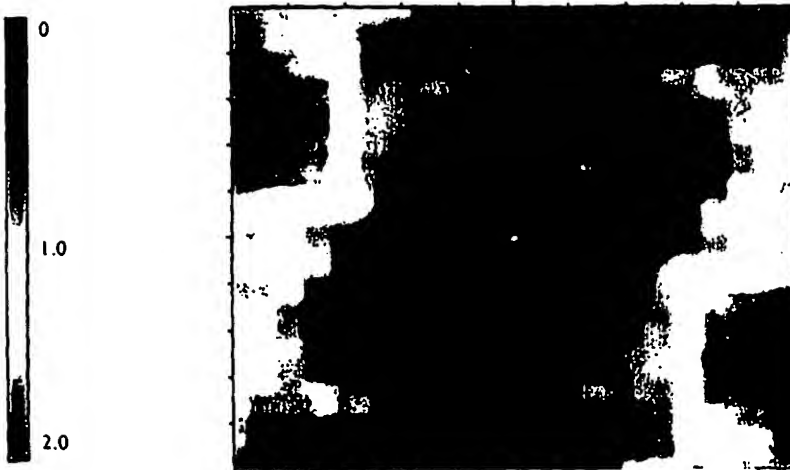


Figure 13 Variogram Map

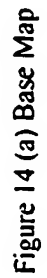




Figure 14 (b) Seismic Section A to B

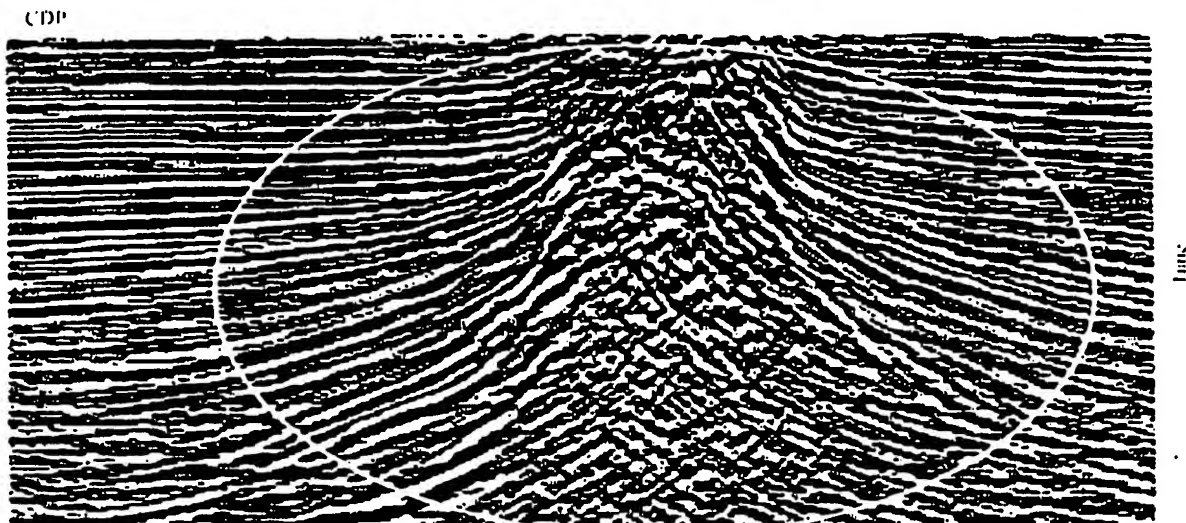


Figure 15 (a) 1999 Prestack Time Migration

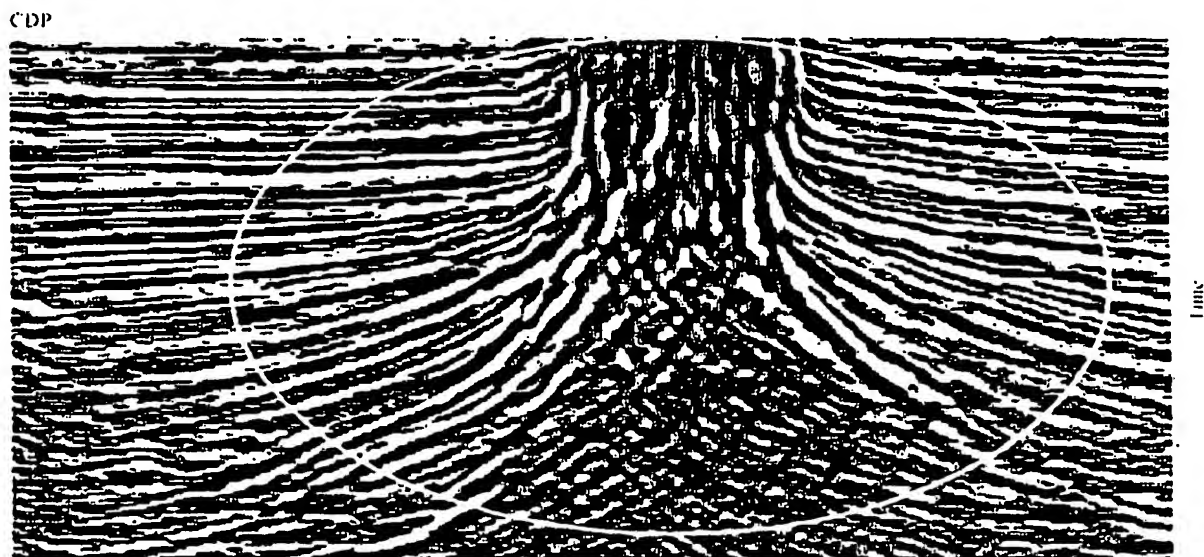
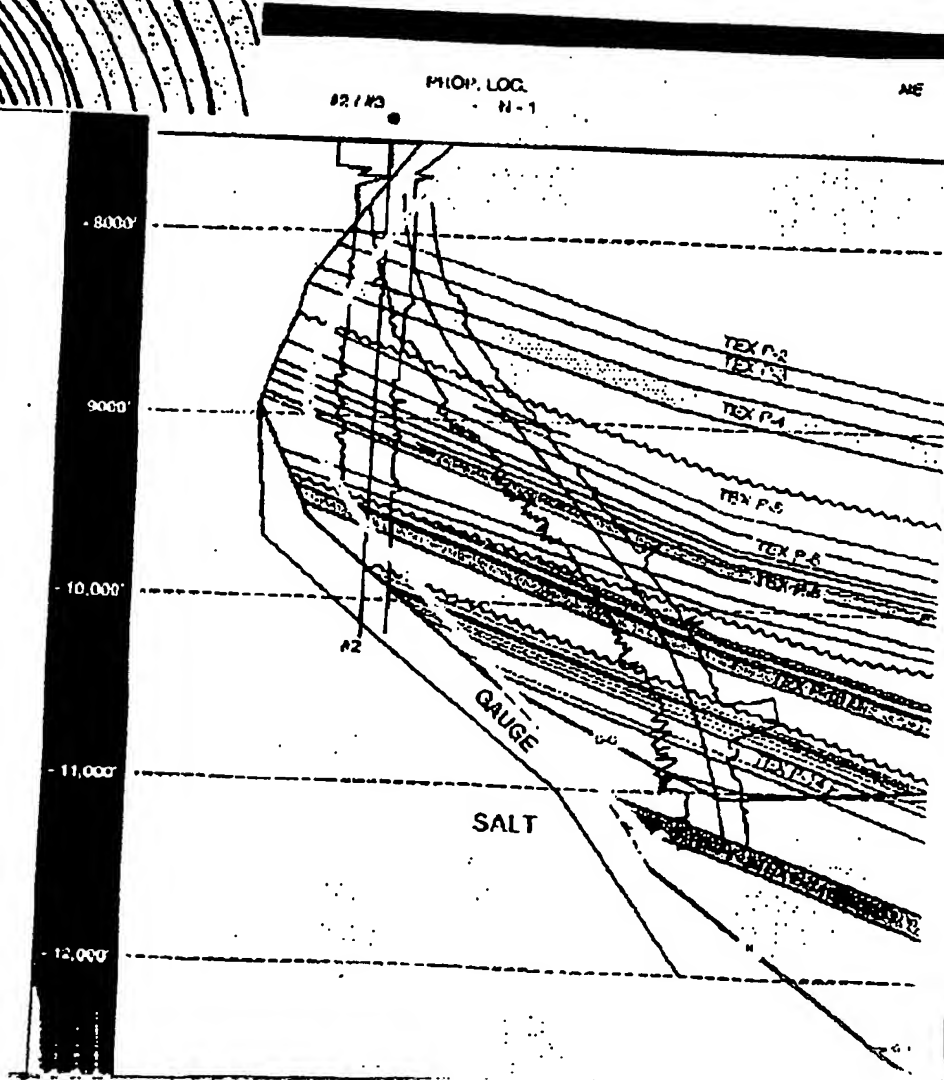
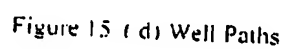
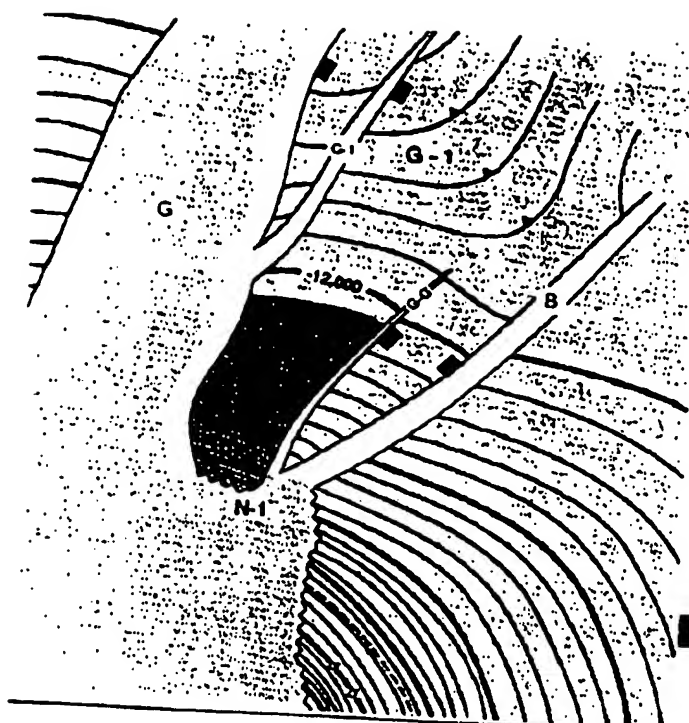


Figure 15 ( b) 2003 Prestack Time Migration

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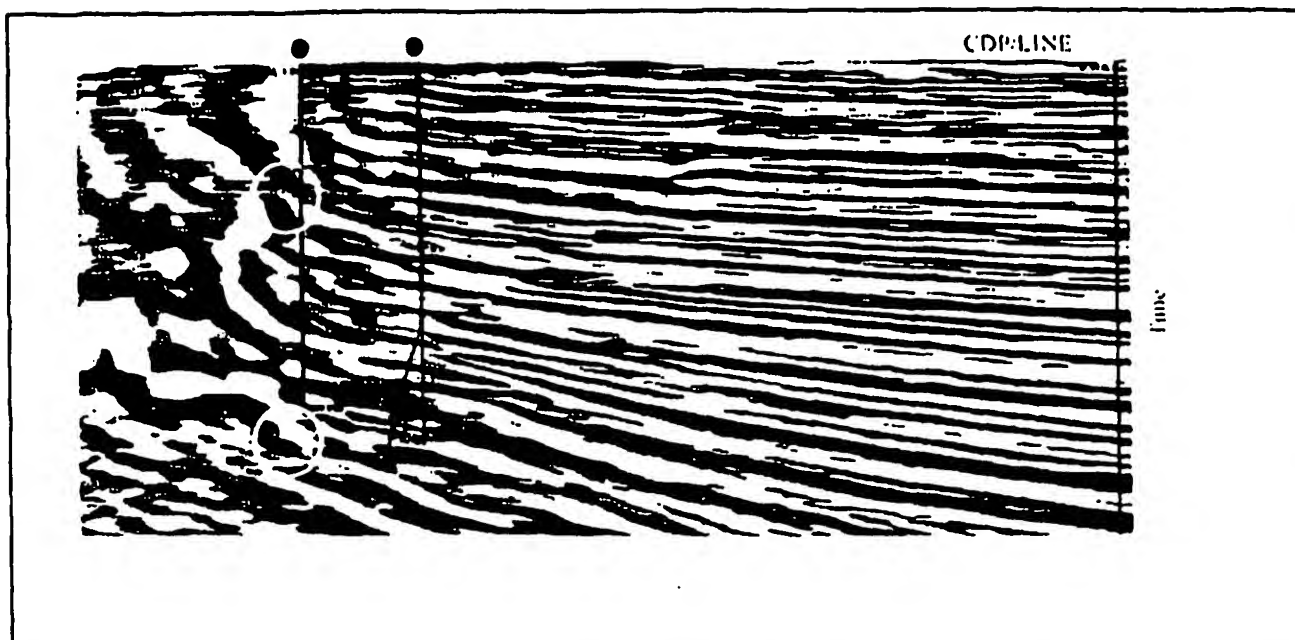


Figure 16 ( a) Prestack Time Migration without Velocity Calibration and Trend Fitting

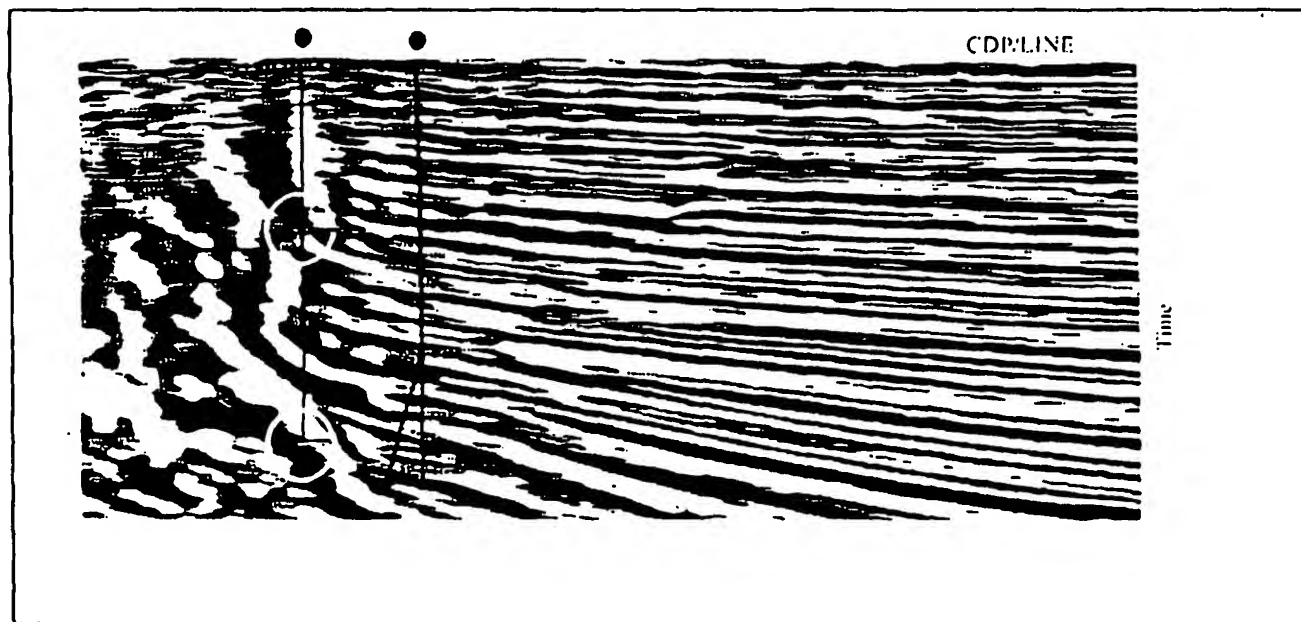


Figure16 ( b) Prestack Time Migration with Velocity Calibration and Trend Fitting

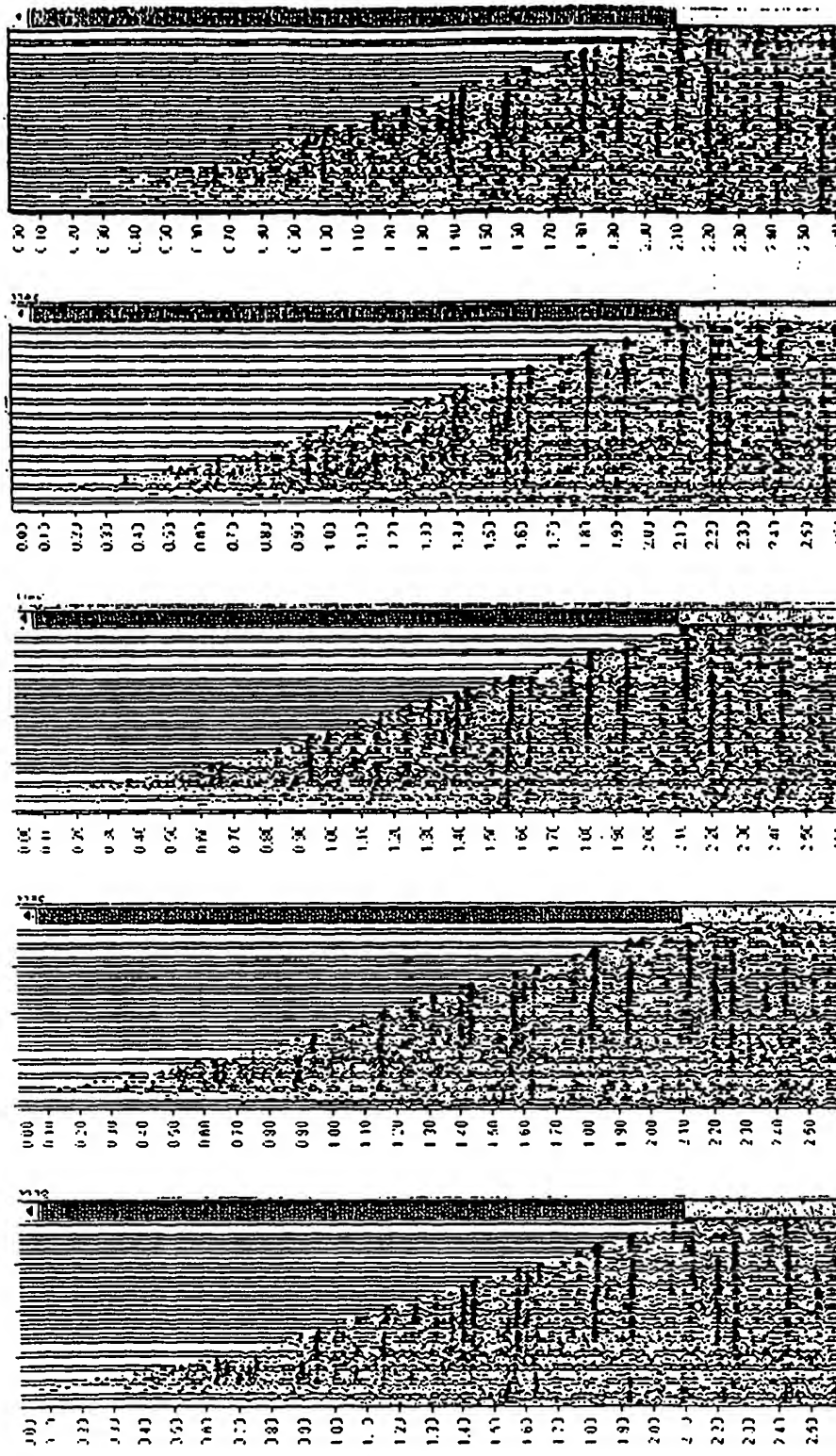


Figure 17 Common Image Point Gathers